

REMARKS

In the last Office Action, the Examiner rejected claims 1, 2, 15, 19 and 20 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,361,151 to Shigemura. Claims 3, 4, 6, 9, 21-23 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of U.S. Patent No. 6,109,740 to Namekawa et al. ("Namekawa"). Claims 5 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of U.S. Patent No. 6,196,655 to Hirasawa et al. ("Hirasawa"). Claim 17 was rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Japanese Patent No. 405229116A to Hiraishi (Hiraishi '116). Claims 16 and 18 were objected to as being dependent upon a rejected base claim, but indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicant and applicant's counsel note with appreciation the indication of allowable subject matter concerning claims 16 and 18. However, for the reasons noted below, applicant respectfully submits that amended independent claims 1 and 15 and corresponding dependent claims 2-6, 17 and 19-25 also patentably distinguish from the prior art of record.

In accordance with the present response, independent claims 1 and 15 have been amended to further patentably

distinguish from the prior art of record. Allowable claims 16 and 18 have been rewritten in independent form to incorporate the subject matter of the corresponding base and intervening claims. The specification has been suitably revised to provide antecedent basis for the claim language. A new abstract which more clearly reflects the invention to which the amended claims are directed has been substituted for the previously submitted abstract.

Applicant respectfully requests reconsideration of his application in light of the following discussion.

Brief Summary of the Invention

The present invention is directed to an ink jet head and to an ink jet recording apparatus utilizing the ink jet head.

Fig. 7 shows a conventional ink jet head for an ink jet recording apparatus. Grooves 102 are formed in a piezo-ceramic plate 101 and are separated by side walls 103. One end portion of each groove 102 extends up to an end surface of the piezo-ceramic plate 101. The other end portion of each of the grooves 102 does not extend up to the other end surface of the piezo-ceramic plate 101 and gradually decreases in depth. Electrodes 105 for applying drive voltages are disposed on surfaces of both side walls 103 of each groove 102. An ink chamber forming substrate 107 has an ink chamber 106

communicating with the end portion of each groove 102 having the decreased depth. The ink chamber forming substrate 107 is connected to the piezo-ceramic plate 101 on the side where the grooves 102 are opened. A passage forming member 109 for sealing one side of the ink chamber 106 and having an ink supply passage 108 for supplying ink to the ink chamber 106 is fixed to the ink chamber forming substrate 107. A nozzle plate 110 is joined to end surfaces of the piezo-ceramic plate 101 and the ink chamber forming substrate 107. Nozzle apertures 111 are formed in the nozzle plate 110 so as to face the respective grooves 102 in the nozzle plate 110. When ink is supplied to grooves 102 via the ink supply passage 10 and a predetermined driving electric field is applied to the side wall 103 of each groove 102 through electrodes 105, the side walls 103 are deformed to vary the capacity of the grooves 102 so that the ink can be discharged from the groove 102 through nozzle apertures 111.

A problem associated with the foregoing conventional ink jet head is that ink cannot be efficiently discharged through the nozzle apertures 111 due to dust and/or bubbles (hereinafter "dust") in the ink. In an effort to resolve this problem, a filter 112 has been provided at the end of the ink supply passage 108 at the side of the ink chamber 106 in order to prevent dust and bubbles in the ink from entering the ink chamber 106. However, while the filter 112 prevents entry of

dust and bubbles of a certain size, it does not completely prevent the entry of dust and bubbles. Additionally, while the use of a finely meshed filter would prevent the entry of dust to a large degree, such a filter disturbs the flow of ink.

The present invention overcomes the drawbacks of the conventional art. Figs. 1-5 show an embodiment of an ink jet head 10 according to the present invention embodied in the claims. The ink jet head 10 comprises a substrate 16 and partition walls 18 disposed on a main surface of the substrate 16 and spaced apart at a preselected interval to form channels 17 each for receiving ink and having a pair of deformable side walls. An ink chamber plate 21 is connected to the substrate 16 to define with the partition walls 18 an ink chamber 20 for supplying ink to the channels 17. Electrodes 19 are connected to the side walls of the channels 17 and are driven by a voltage signal to deform the side walls to vary the volume in the channels 17 to thereby eject ink from the channels 17. A nozzle plate 22 is connected to the substrate 16 and has nozzle openings 23 each disposed in communication with respective ones of the channels 17 so that when the electrodes 19 are driven by a voltage signal ink is ejected from the channels 17 through the nozzle openings 23. A passage forming member 12 is connected to the ink chamber plate 21 and has an ink supply passage 26 disposed in communication with the ink

chamber 20 for supplying ink contained in an ink storage device (not shown) to the ink chamber 20. The passage forming member 12 also has ink discharge passages 27 and 28 for discharging ink from the ink chamber 20. Each of the ink discharge passages 27, 28 is independent from the ink supply passage 26 so that ink is supplied to the ink chamber 20 through the ink supply passage 26 without passing through at least a portion of each of the ink discharge passages 27, 28.

By the foregoing construction, unwanted substances, such as dust particles and bubbles, contained in the ink disposed in the ink chamber and the channels of the ink jet head can be reliably removed from the ink chamber and the channels. For example, in an embodiment of a method for removing unwanted substances from ink in an ink jet head according to the present invention, the ink which contains unwanted substances and which is disposed in the ink chamber and channels of the ink jet head are first stirred to cause the unwanted substances to accumulate at one or more regions of the ink chamber and channels. The stirring step may be conducted, for example, by absorbing the ink which contains the unwanted substances through one or both of the discharge passages. The stirred ink accumulated at the one or more regions is then discharged through one or both of the discharge passages to thereby remove the unwanted substances from the ink. By this method, unwanted substances contained

in the ink disposed in the ink chamber and the channels of the ink jet head can be removed with high reliability to thereby achieve high quality printing and improved durability.

Traversal of Prior art Rejections

Rejection Under 35 U.S.C. §102(b)

Claims 1, 2, 15, 19 and 20 were rejected under 35 U.S.C. §102(e) as being anticipated by Shigemura. Applicant respectfully traverses this rejection and submits that amended independent claims 1 and 15 and corresponding dependent claims 2, 19 and 20 recite subject matter which is not identically disclosed or described in Shigemura.

Amended independent claim 1 is directed to an ink jet head and requires a substrate, a plurality of partition walls disposed on a main surface of the substrate and spaced apart at a preselected interval to form a plurality of channels each for receiving ink, an ink chamber plate connected to the substrate to define with the partition walls an ink chamber for supplying ink to the channels, and a passage forming member connected to the ink chamber plate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber, the ink discharge passage being independent from the ink supply

passage so that ink is supplied directly to the ink chamber through the ink supply passage without passing through at least a portion of the ink discharge passage. No corresponding structural combination is disclosed or described by Shigemura.

Shigemura is directed to an ink jet recording head having a substrate 11, partition walls 3a-3e, channels 1ab, 1cd, 1ef, an ink chamber plate 8 having an ink supply opening 9 in communication with an ink chamber, and a passage forming member (ink pool) 12 (Figs. 1-3). As shown in Fig. 3 of Shigemura which has been reproduced herewith as Exhibit A, the passage forming member 12 has a first passage A through which ink is supplied and a second passage or chamber B disposed in communication with the first passage B for receiving the ink supplied through the first passage A. The second passage is in turn disposed in communication with the ink supply opening 9 of the ink chamber plate 8.

The Examiner contends that in Shigemura the second passage B is an ink supply passage and that the first passage A is an ink discharge passage of the ink jet head. However, while the second passage B may be fairly construed as an ink supply passage (i.e., a passage through which ink is supplied to the ink supply opening), applicant disagrees that the first passage A is an ink discharge passage of the ink jet head. More specifically, in Shigemura ink is supplied to the second

passage B through the first passage A, and thus the first passage A is a supply passage of the ink jet head. There is simply no disclosure in Shigemura that the passage A also functions as an ink discharge passage (i.e., a passage through which ink is discharged from the ink chamber). Accordingly, applicant respectfully submits that Shigemura does not disclose or describe the ink discharge passage recited in claim 1.

Nevertheless, in order to expedite prosecution, independent claim 1 has been amended to further patentably distinguish from the prior art of record by reciting that the ink discharge passage is independent from the ink supply passage so that ink is supplied directly to the ink chamber through the ink supply passage without passing through at least a portion of the ink discharge passage. This structure and corresponding function is not disclosed or described by Shigemura.

Even if the first passage A of the passage forming member 12 in Shigemura were interpreted to be an ink discharge passage as proposed by the Examiner, such an ink discharge passage does not meet the structural limitation recited in amended independent claim 1. More specifically, the purported ink discharge passage (first passage A) in Shigemura is not independent from the ink supply passage (second passage B) so that ink is supplied directly to the ink chamber through the

ink supply passage without passing through at least a portion of the ink discharge passage. Stated otherwise, in Shigemura ink supplied directly to the ink supply passage B must necessarily pass through the entire ink discharge passage B since the only way for the ink to enter the ink supply passage B is through the ink discharge passage A (see also the passage forming member 12 in Fig. 2 of Shigemura).

Independent claim 15 is also directed to an ink jet head and requires a passage forming member connected to the substrate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber, the ink discharge passage being independent from the ink supply passage so that ink supplied to the ink chamber through the ink supply passage does not pass through at least a portion of the ink discharge passage. No corresponding structural and functional combination is disclosed or described by Shigemura as set forth above for amended independent claim 1.

In the absence of the foregoing disclosure recited in independent claims 1 and 15, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art

reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found."); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Shigemura for the reasons stated above. Furthermore, Shigemura does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Shigemura's ink jet recording head to arrive at the claimed invention.

Claims 2 and 19-20 depend on and contain all of the limitations of amended independent claims 1 and 15, respectively, and, therefore, distinguish from the references at least in the same manner as amended claims 1 and 15.

In view of the foregoing, applicant respectfully requests that the rejection of claims 1, 2, 15, 19 and 20 under 35 U.S.C. §102(e) as being anticipated by Shigemura be withdrawn.

Rejections Under 35 U.S.C. §103(a)

Claims 3, 4, 6, 9, 21-23 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Namekawa. Applicant respectfully traverses this rejection and submits that the combined teachings of Shigemura and Namekawa do not disclose or suggest the subject matter recited in claims 3, 4, 6, 9, 21-23 and 25.

Shigemura does not disclose or suggest the subject matter recited in amended independent claims 1 and 15 as set forth above for the rejection of claims 1, 2, 15, 19 and 20 under 35 U.S.C. §102(e). Claims 3, 4, 6, 9 and 21-23, 25 depend on and contain all of the limitations of amended independent claims 1 and 15, respectively, and, therefore, distinguish from the reference at least in the same manner as claims 1 and 15.

The Examiner cited the reference to Namekawa for its disclosure of a check valve permitting only a flow from an ink chamber to the outside, a communication passage sealed by securing a cap member to a passage forming member through an O-ring, and absorbing means connected to the communicating passage. However, as recognized by the Examiner, Namekawa

does not disclose or suggest a passage forming member connected to the ink chamber plate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber, as recited in each of independent claims 1 and 15. Likewise, Namekawa does not disclose or suggest an ink discharge passage being independent from the ink supply passage so that ink supplied to the ink chamber through the ink supply passage does not pass through at least a portion of the ink discharge passage, as recited in each amended independent claims 1 and 15. Since Namekawa does not disclose or suggest these structural features and corresponding functions recited in independent claims 1 and 15, from which claims 3, 4, 6, 9 and 21-23, 25 respectively depend, it does not cure the deficiencies of Shigemura.

It is well established that in assessing patentability of a claimed invention, all claim limitations must be suggested or taught by the prior art. In re Royka, 180 USPQ 580 (CCPA 1974). In this case, Shigemura and Namekawa, either alone or in combination, do not disclose or suggest all of the limitations recited in independent claims 1 and 15, from which claims 3, 4, 6, 9 and 21-23, 25 respectively depend, as set forth above.

In view of the foregoing, applicant respectfully requests that the rejection of claims 3, 4, 6, 9, 21-23 and 24 under 35 U.S.C. §103(a) as being anticipated by Shigemura in view of Namekawa be withdrawn.

Claims 5 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Hirasawa. Applicant respectfully traverses this rejection and submits that the combined teachings of Shigemura and Hirasawa do not disclose or suggest the subject matter recited in claims 5 and 24.

Shigemura does not disclose or suggest the subject matter recited in amended independent claims 1 and 15 as set forth above for the rejection of claims 1, 2, 15, 19 and 20 under 35 U.S.C. §102(e). Claims 5 and 24 depend on and contain all of the limitations of independent claims 1 and 15, respectively, and, therefore, distinguish from the reference at least in the same manner as claims 1 and 15.

The Examiner cited the reference to Hirasawa for its disclosure of a filter 30 disposed between an ink supply passage 17 and an ink chamber 12 (Fig. 4). However, as recognized by the Examiner, Hirasawa does not disclose or suggest the specific structure and corresponding function of the passage forming member recited in amended independent claims 1 and 15 from which claims 5 and 24 respectively depend. Since Hirasawa does not disclose or suggest these

structural and functional features, it does not cure the deficiencies of Shigemura. Accordingly, one of ordinary skill in the art would not have been to modify the references to attain the claimed subject matter.

In view of the foregoing, applicant respectfully requests that the rejection of claims 5 and 24 under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Hirasawa be withdrawn.

Claim 17 was rejected under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Hiraishi '116. Applicant respectfully traverses this rejection and submits that the combined teachings of Shigemura and Hiraishi '116 do not disclose or suggest the subject matter recited in claim 17.

Shigemura does not disclose or suggest the subject matter recited in amended independent claim 15 as set forth above for the rejection of claims 1, 2, 15, 19 and 20 under 35 U.S.C. §102(e). Claim 17 depends on and contains all of the limitations of independent claim 15 and, therefore, distinguish from the reference at least in the same manner as claim 15.

The secondary reference to Hiraishi '116 and its counterpart U.S. Patent No. 5,432,540 to Hiraishi ("Hiraishi '540") disclose an ink jet head. With reference to Hiraishi '116 (see abstract and Figs. 1-7)) and Hiraishi '540 (see col.

4, line 60 to col. 5, line 23 and Figs. 1-7)), the ink jet head has a substrate 1 which is subjected to a cutting process to form barriers or partition walls 5 in spaced-apart relation to define channels 2. The channels 2 are communicated with each other at both ends by a common ink reservoir 7. Ink is introduced through ink-supply inlets 6 and is supplied to the respective channels 2 through the common ink reservoir. A step is formed at opposing ends of the substrate 1 to form shallow channels 12. Electrodes are disposed in the channels 12 for connection to electrodes formed on side surfaces of the partition walls 5. A sealing plate 10 is mounted to each of the stepped portions to prevent ink from escaping the common ink reservoir 7.

Applicant respectfully submits that the structure of the ink jet head recited in independent claim 15 is patentably distinct from the structure of the ink jet head disclosed by Hiraishi '116 and Hiraishi '540. More specifically, in the statement of rejection, the Examiner contends that Hiraishi '116 discloses two ink "discharge passages (6)". However, contrary to the Examiner's contention, the passages denoted by reference numeral 6 in Hiraishi '116 and Hiraishi '540 correspond to ink supply passages or inlets, not ink discharge passages (see col. 5, lines 21-23).

Moreover, since Hiraishi '116 and Hiraishi '540 do not disclose ink discharge passages as set forth above, the

references do not disclose or suggest an ink discharge passage which is independent from the ink supply passage so that ink supplied to the ink chamber through the ink supply passage does not pass through at least a portion of the ink discharge passage, as recited in amended independent claim 15.

Since Hiraishi '116 and Hiraishi '540 do not disclose or suggest the foregoing structural and functional combination recited in amended claim 15, from which claim 17 depends, they does not cure the deficiencies of Shigemura. Accordingly, one of ordinary skill in the art would not have been to modify the references to attain the claimed subject matter.

In view of the foregoing, applicant respectfully requests that the rejection of claim 16 under 35 U.S.C. §103(a) as being unpatentable over Shigemura in view of Hiraishi '116 be withdrawn.

In view of the foregoing amendments and discussion,
the application is now believed to be in condition for
allowance. Accordingly, entry of this amendment and favorable
reconsideration and allowance of the claims are most
respectfully requested.

Respectfully submitted,

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